ASp
la revue du GERAS

69 | 2016
Concepts and Frameworks in English for Specific Purposes

Science as vocation? Discipline, profession and impressionistic sociology

La science est-elle un métier ? Discipline, profession et sociologie impressionniste

Michel Dubois

Electronic version
URL: http://journals.openedition.org/asp/4784
DOI: 10.4000/asp.4784
ISSN: 2108-6354

Publisher
Groupe d'étude et de recherche en anglais de spécialité

Printed version
Date of publication: 9 March 2016
Number of pages: 21-39
ISSN: 1246-8185

Electronic reference
Michel Dubois, « Science as vocation? Discipline, profession and impressionistic sociology », *ASp* [Online], 69 | 2016, Online since 01 March 2017, connection on 02 November 2020. URL : http://journals.openedition.org/asp/4784 ; DOI : https://doi.org/10.4000/asp.4784

Science as vocation? Discipline, profession and impressionistic sociology

La science est-elle un métier ? Discipline, profession et sociologie impressionniste

Michel Dubois

1 "Discipline" and "profession" are two basic categories for describing contemporary societies. Nowadays, most of our social achievements are interpreted as part of professional frameworks. Moreover, the division of labour between professional groups constitutes a pivotal social feature and a major source of social inequalities. Discipline, on the other hand, is generally construed as the basis of expert knowledge on which professional groups heavily rely. The medical profession, which has frequently been studied by sociologists (Merton *et al.* 1957; Freidson 1984 [1970]), is a case in point. Seen from a wider perspective, disciplines constitute a transnational institutional infrastructure that tends to produce dividing lines between legitimate knowledge and illegitimate knowledge.

2 Sociological literature on the categories of "discipline" and "profession" is abundant.[1] As suggested by the title of this article, I discuss this literature through a specific case: science as an occupation. The reasons for this choice are, at least, twofold. First, one of the core objectives of the sociology of science (since its inception) has obviously been to study the many aspects of the "disciplinary regime" of knowledge production (Shinn & Joerges 2002). Disciplines are frequently not only perceived as a primary frame of reference in scholarship and science (Heilbron 2004a), they are also construed by sociologists as "empirical strategic sites" (Merton & Thacray 1972; Lemaine *et al.* 1977; Heilbron 2004b; Dubois 2014a, 2014b). Secondly, as F. Champy indicated (2009), one of the first contributions to the sociological study of professions has been precisely devoted to the scientific and/or academic occupation. On the occasion of his lecture *Wissenschaft als Beruf*, delivered on November 7, 1917, Max Weber, the German founder of sociology, chose a term—"*Beruf*"—that means "profession" but that is also endowed with a religious dimension as it also refers to science as a "calling" (Weber 2004 [1919]).

3 Besides its great intrinsic value, Weber's lecture shows that it is difficult to clearly distinguish between the professional and the disciplinary dimensions of science. The dual structure of the lecture seems to acknowledge the existence of a strong demarcation between the two categories. The first part of the lecture focuses on the "external organization of science" (*Beruf* as *profession*) through a comparative analysis of the scientific *careers* in Germany and the United States, whereas the second part is centred on the values that are needed (*Beruf* as *calling*) to unconditionally embrace the disciplinary organization of scientific practices: "[...] the inner vocation of science [...] is determined in the first instance by the fact that science has entered a stage of specialization that has no precedent and that will continue for all time" (*ibidem*: 7).

4 However, as clear as that distinction might seem at the beginning of the lecture, it is rapidly discarded by Weber. His analysis of scientific values is recast in professional terms: "what is the inner attitude of the scientist himself to his profession? [...]" (*ibid.*: 12); "Science today is a profession practiced in specialist disciplines [...]" (*ibid.*: 27). The discipline is conceptualized as *cognitive dynamics* (a growing specialization of knowledge) but also as a *delimited institutional space* devoted to scholars sharing the same professional value(s). And there are obviously many good reasons to retrospectively consider Weber's lecture as a first landmark in the sociological study of the deontology of science.

5 Although sociologists of science, almost one century later, have generally forgotten the Weberian notion of "*Beruf*", they nonetheless adopt the same impressionistic outlook on the categories of "profession" and "discipline". The objective of the first section of this article is to briefly illustrate this interpretative pitfall with a few examples drawn from the sociological literature devoted to the socialization process in science. For the purposes of this article, I have limited my discussion to this specific literature and have not explored whether this impressionistic approach is widespread or not in the contemporary sociology of science, or even more widely in general sociology.

6 The second section of the article aims to address some key conceptual and definitional elements in order to clarify the two categories and, more broadly, the nature of their mutual relations. Building on E. Freidson's (1970 [1984]), Y. Gingras' (1991) and Stichweh's (1992) general lines of arguments, I suggest that "profession" and "discipline" correspond to two distinct phenomena that should not be confused without sufficient conceptual care. In a brief conclusion, I will discuss how an already well-documented trend in the dynamics of science and technology may have important consequences for the balance between these two categories in the sociological analysis of science.

1. Lessons from socialization studies

7 Nowadays, scientific research is "naturally" viewed as a full time occupation. Approximately seven million people daily engage in countless research and development (R&D) activities around the world.[2] This situation is of course dramatically different from the one observed one century ago, in the 19th century and before. At that time, not only was scientific research still practiced on a limited demographical scale, but science was not the main occupation of early practitioners of science. Historians of science have described the German origin of this transformation (McLeeland 1991) but also questioned the illusory simplicity of the notion of

"professionalization" commonly used to describe this transformation (MacLeod 1972; Porter 1978; Goldstein 1984; Broman 1995; Golinski 1998; Barton 2003).

8 Following Weber's focus on the basic values of science, the first American sociologists of science proposed to define the scientific community as a professional group providing several means to guarantee its ability to produce a "certified" knowledge, among which a specialized training process (scientific education) and a code of conduct (a normative structure of science). Merton's 1942 classical description of the *ethos of science*[3] paved the way for a research programme devoted to socialization in science. Socialization should be understood here as the process through which doctoral students "internalize" the types of commitments that they need to endorse in order to play a useful role in their future professional group. If the main contributors to this programme were at first Merton's close collaborators (Hagstrom 1965; Zuckerman 1978), the issue has recently been taken up again by social scientists investigating the impact of "new norms of science" on higher education in the 2000s (Delamont & Atkinson 2001; Campbell 2003; Weidman & Stein 2003; Golde 2005; Gardner 2007; Barnes & Randall 2012).

9 There are, at least, two striking features in this recent literature on the socialization process in science: first, its impressionistic use of the categories of profession and discipline, i.e. the absence of clear conceptual elaboration for both categories; second, a general analytical blindness to the differences between the two categories, which very significantly weakens sociological investigation.

10 A few examples may be useful here to illustrate our criticisms of recent literature on these issues. Delamont and Atkinson (2001) provide an interesting account of academic socialization based on interviews with doctoral scientists and their supervisors in biochemistry, earth sciences and physical geography. They recognize that the relevant literature on socialization in science, although limited in volume, comes from the sociology and anthropology of science and technology, the sociology of the professions, and the sociology of education. Their initial claim is undeniably stimulating: "Doctoral students in laboratory and field sciences are being socialized into a profession and into an academic discipline" (2001: 87). But not only is the reader incapable to find in the following pages of the article any in-depth definitions of these two categories—which, however, are central to the study— but the same empirical facts, practices or resources discussed through the article (the know-how, the tacit skills required, etc.) are alternatively described in professional and disciplinary terms,[4] just as though these two categories were perfectly interchangeable.

11 Campbell's (2003) contribution on socialization[5] focuses on "the social process of managing students", or, in other words, how science faculty members view and engage in the process of preparing the future generation of scientists. The empirical material is a series of interviews with scientists in biology, chemistry, geology and physics. Most studies on scientific training suggest that whether scientists become successful or not is—directly or indirectly—linked to the quality of training they received from their sponsors or teachers. But are they trained for science as a discipline, or science as a profession? Campbell's article actually mobilizes both categories—once again without any substantial definitions—and uses them alternatively to describe the same phenomena. Quoting Barbara Reskin's study on the issue of academic sponsorship, Campbell claims that "in training students, sponsors transmit to them *professional*

(italics added, MD) skills that will enhance their scientific performance and hence their job prospects" (2003: 902). But a few pages later Campbell (*ibidem*: 909) notes that

> through formalized courses, scientists present their worldviews to new members, and provide students with opportunities for developing attitudes, skills and knowledge, *appropriate to the discipline* (italics added) at hand.

12 Gardner's investigation (2007) on doctoral students' socialization in chemistry and history is a third example of literature on the socialization process in the scientific world. Gardner's general objective (2007: 729) is to

> understand the processes of socialization that occur throughout the degree programs of [...] 20 graduate students in chemistry and history and that assist them in developing the knowledge, skills, and beliefs needed for success in both the professional and interpersonal spheres of the discipline.

13 If, like Delamont, Atkinson or Campbell, Gardner does not provide any clear definition, this sentence seems to imply that the discipline should be understood as a social unit composed of two main "spheres": professional vs interpersonal. The professional sphere of the discipline refers, according to Gardner, to the development and transmission of "a set of skills [...] that the students need to obtain before graduating" (2007: 734). These skills are obviously a precondition for obtaining a post-doctoral appointment and/or achieving a scientific career. But Gardner's students, in their interviews, do not simply mention jobs and careers, they also describe their socialization in science as a process of "getting into the research mindset", which means gradually adopting a "set of dispositions" that prepare them to appropriately fit into their own disciplinary milieus (chemistry or history). Once again, regrettably, the categories of discipline and profession appear to be largely interchangeable as analytical categories.

14 There is no need here to multiply examples and references. The general lesson that emerges from this brief discussion is that, before starting any empirical investigation, the sociologist should overcome this mostly impressionistic use of the categories of discipline and profession.

2. What is a discipline and why should it be distinguished from a profession?[6]

15 The notion of "discipline" is commonly used to describe a specific area of specialized knowledge associated with a specific form of collective control over its production and diffusion. The sociological inquiry on disciplines is closely related to a general reflection on the various ways in which modern institutions dedicated to the production and dissemination of knowledge implement a triple degree of differentiation.

16 The first degree, at a micro level, allows to distinguish the pupil from the teacher, the apprentice from the master. Discipline, in its original sense, is a component of the pedagogical relationship. *Disciplina* is derived from the Latin *discere* (learning), and the term explicitly focuses on the knowledge transmitted through the pedagogical relationship, but also on the methods used for inculcating this knowledge. It generally represents the side of the student as opposed to the teacher, more inclined toward the *doctrina* than the *disciplina*. H. Zuckerman has described the many facets of the discipline conceived as a pedagogical relationship (1978, chapter 4). Most Nobel

laureates interviewed by Zuckerman consider that acquiring information and knowledge is part of any apprenticeship in science. But most of them also believe that knowledge is only a small part of what is durably inculcated during this period through the relationship with the master: "It's the contact: seeing how they operate, how they think, how they go about things [...]. It's learning a style of thinking, I guess" (from an interview of a chemist, quoted by Zuckerman 1978: 122).

17 The second degree, at a meso level, corresponds to the division of scientific labour within the corresponding community. The discipline is a subunit of knowledge production, distinct from other sub-units of knowledge production. The contemporary significance of the disciplinary regime of science is partly anchored in the frequently taken-for-granted idea that the existence of these subunits implies a form of "natural" or "harmonious" division of labour. Innumerable monographs explore the birth, growth and sometimes declining phases of disciplines like chemistry, physics, biology, geology, etc. (see Dubois 2014a, for references). The sum of all these subunits constitutes a crucial dimension of the internal structure of the scientific community. Weber's lecture on science as vocation explicitly refers to this growing internal differentiation of science.[7] It is from that same perspective that R. Stichweh (1991, 1992, 2003) or more recently J. Jacobs (2014) defined discipline as a "key unit of internal differentiation in science", i.e. a delimited set of individuals working simultaneously as researchers but also as teachers within a specific cognitive perimeter. Stichweh's objective is to reconstruct, within a functional framework inspired by the German sociologist N. Luhmann, the long-term historical transition from discipline conceived as a pedagogical relationship (the first degree of differentiation) to discipline conceived as a social system of scientific labour and scientific communication (the second degree of differentiation):

> The disciplinary differentiation of science is based on the organizational growth and the organizational pluralization of science. In Germany, the first country to witness disciplinary differentiation, organizational growth appears to have been the more relevant causal condition. In the 18th century, the University of Göttingen was the first instance in which considerable growth in the provision of organizational roles, in particular in the philosophy faculty, was accompanied by a readiness to accept increasingly specialized descriptions of professorial chairs. (Stichweh 1992: 9)

18 Finally, at a macro level, the discipline is conceived as a "regime"—the disciplinary regime (Shinn 2002)—i.e. a dominant culture of science. Claiming that a specific area of research has acquired a disciplinary status or regime does not only mean that it has achieved a form of (second degree) internal differentiation within the scientific community. Before that, this area of research has to be collectively perceived as a legitimate component of science. And this process of legitimization associates the notion of discipline to an external form of (third degree) differentiation. It is in that sense that the disciplinary regime of science (among many other possible regimes) should be interpreted as a transnational infrastructure aiming to produce a boundary between science and non-science. The sociological analysis of disciplines is most often "differentiationist", to the extent that it stresses the ability of scientists to produce, through the notion of discipline, a basic discontinuity not only between their practices and the practices of the colleagues belonging to other scientific subunits, but, more importantly, from the practices characteristic of non-scientific social collectives. As emphasized by T. Gieryn (1999: 14-15), discipline redefined as the dominant

> cultural space of science is a vessel of authority [...] [and] this epistemic authority is sustained through repeated and endless edging and filling of its boundaries [...] it is enacted as people debate (and ultimately decide) where to locate the legitimate jurisdiction over natural facts.

19 The study of the socio-cognitive origin of these three degrees of disciplinary differentiation, of their organisational and practical implementation, and of their intentional and non-intentional consequences, is of course a major issue for the contemporary study of science. I wish to focus on two particular issues that are a frequent source of confusion in sociological discourse.

20 The first issue has to do with the enduring existence of disciplines and their ability to remain a dominant culture of science, a "vessel of authority" in the words of T. Gieryn. Why should sociologists be cautious about considering "discipline" as an empirical unit of investigation? Because, according to sociologists of science such as Knorr-Cetina (1982: 117),

> scientists' laboratory reasoning not only takes us outside the walls of the research site, it also takes us beyond the borders of the specialty under which a scientist—or a piece of research—comes to be classified. We are thus confronted with arenas of action which are transepistemic; they involve a mix of persons and arguments that do not fall naturally into a category of relationships pertaining to 'science' or 'the specialty' [...].

21 Concepts, such as that of discipline, that are precisely designed to account for the processes of internal and external differentiations, are described as powerless once confronted to

> the complex texture of knowledge as practiced in the deep social spaces of modern institution. To bring out this texture, one needs to magnify the space of knowledge-in-action, rather than simply observe disciplines or specialties as organizing structures. (Knorr-Cetina 1999: 2-3)

22 The same general point was made by Gibbons et al. in their controversial essay about *The New Production of Knowledge* (1994). Their main argument (the evolution of science from mode 1 to mode 2) is based on a striking feature of contemporary science, namely its transdisciplinarity (1994: 22 & 27):

> The proliferation of sites outside of normal disciplinary structures and institutions developed since the turn of the nineteenth century, in which recognisably competent research is taking place, opens up a vast field of interconnections. As interactions multiply, the epistemological status of the knowledge thus produced does not follow traditional, that is, disciplinary criteria [...] the intellectual agenda is not set within a particular discipline, nor is it fixed by merely juxtaposing professional interests of particular specialists in some loose fashion leaving to others the task of integration at a later stage. Integration is not provided by disciplinary structures—in that regard the knowledge process is not interdisciplinary, it cuts across disciplines—but is envisaged and provided from the outset in the context of usage or application [...].

23 Should we really consider these observations as a death certificate for the category of discipline? Are disciplines such as physics, biology, economics, obsolete? My scepticism comes from the observation that the transdisciplinarity described by Gibbons *et al.* is after all nothing really new. Granted, the notions of trans-, inter- or multi-disciplinarity currently appear as attractive. As emphasized by J. Jacobs (2014: 2), as debates on interdisciplinarity have become more frequent, "the adjective 'interdisciplinary' now generally has a positive valence [...]. It sometimes seems that interdisciplinarity has become an end in itself". However, beyond this buzzword effect,

it is worth noting that innumerable studies dedicated to the emergence, growth and decline of disciplines and specialties have extensively documented the ways in which scientists are innovating by standing in the interstices of the pre-existing disciplinary framework, or by operating recombinations from multiple available specialties. Innovation in science and technology is frequently the consequence of an interstitial work. One example might suffice: N. Mullins's (1972) classical study on the origins of molecular biology shows how the emergence of a specific discipline was the product of an interaction between physicists (Delbrück), biologists (Timofeeff-Rossovsky), bacteriologists (Luria), biochemists (Cohen), etc.

24 Mullins's study demonstrates, if needed, the ability of scientists to suspend, intellectually and organizationally, pre-existing disciplinary boundaries in order to develop an innovative research programme. But does it also demonstrate the obsolescence of the disciplinary regime? Obviously not. These interstitial locations, these collaborations and recombinations are possible precisely because of the pre-existence of a disciplinary infrastructure. It is a truism that appears to be overlooked by many: disciplinary infrastructure is what makes them possible. Furthermore, once sufficiently advanced, it is not infrequent (although it is not always the case) that emerging collective transdisciplinary scientific practices change and gradually acquire an institutional status as a discipline or a specialty. A trandisciplinary practice of science does not necessarily maintain a mutually exclusive relationship with disciplinary infrastructure. Rather, it represents a modality of innovation and knowledge transfer within this infrastructure, and a major cause of its evolution. The segmentation of the disciplinary regime of science is not given once and for all, but evolves under the influence of various factors, among which the transdisciplinary practices of the members of the scientific community. There is no point in adopting an *a priori* binary representation: a static disciplinary regime *vs* a dynamic transdisciplinary regime. It seems much more relevant to study the specific temporalities related to each of these regimes, and to investigate their various forms of interaction and their collective consequences. Even Knorr-Cetina does not seem to be totally convinced by her own argument since, after proclaiming the uselessness of the category of discipline, she nevertheless claims that her own study has been "performed *in two disciplines* [italics added, MD], experimental high physics and molecular biology" (1999: 17).

25 This type of inconsistency (proclaiming the abandonment of a category while continuing to use it) stresses the importance for sociologists to clearly dissociate at least two levels of analysis. The first level may be defined in terms of "cluster" (Mullins 1972) or "research area" (Whitley 1976). Both terms represent a minimal form of scientific grouping, the members of which are aware of forming some kind of community. For Mullins, "[a] cluster forms when scientists become self-conscious about their patterns of communication and begin to set boundaries around those who are working on their common problem" (1972: 69). For Whitley (1976: 472),

> research areas are collectivities based on some degree of commitment to a set of research practices and techniques. Membership is defined in terms of agreed procedures for specifying research problems and for selecting appropriate techniques to operate on them. In different areas these procedures will be more or less clearly formulated, understood and adhered to, but so long as there is some such set of norms to which scientists are committed the intellectual basis for a research area as a social grouping exists.

26 Researchers who, regardless of their different disciplinary backgrounds, share the same commitment to a set of research questions (problems and enigmas), techniques and practices that allow them to maintain relations of exchange and cooperation, belong to these elementary scientific groups. This informal social structure of science is an ordinary place for the production of knowledge—one that has attracted the attention of (micro-)sociologists of science in the 1980s. And this interstitial collective body defined in terms of research area or cluster is in itself neither a specialty nor a discipline.

27 Hence the need to properly identify a second level of analysis, that of the actual discipline (the specialty being understood here as a disciplinary subunit) which corresponds to the institutionalized form of research, teaching and training activities. There is no simple relationship between a research area and a discipline. One is not necessarily the cause of the other. As emphasized by Lenoir (1997: 53),

> one temptation is to treat disciplines as the accreted results of research activity, packed down and distilled into the teaching wing of science. This has the undesired consequence of conflating what goes on at the site of research with disciplinary activity, which [...] are not identical. Scientists at the research front do not perceive their goal as expanding a discipline. Indeed, most novel research, particularly in contemporary science, is not confined within the scope of a single discipline, but draws upon work of several disciplines.

28 Lenoir focuses here clearly on the fact that a discipline integrates in a single framework research activities and teaching activities.[8] Discipline corresponds to the sum of knowledge produced and taught in the academic sphere, and most of the apprentices in science become familiar with research activities within the existing array of disciplinary divisions. But, more fundamentally, Lenoir stresses the fact that scientists do not necessarily have disciplinary objectives and, further, that not all scientific groups are meant—or sometimes able—to acquire a lasting institutional form.[9] Proclaiming from this unwillingness or this inability a general thesis in support of the so called "end of disciplines" seems at least a bit too hasty.

29 This brings me to the second point I wish to discuss, namely the analytical distinction between "discipline" and "profession". A discipline is frequently characterized as a primary unit of internal differentiation in science, closely related to the institutionalization of a pre-existing collective scientific practice that has multi-, inter- or trans-disciplinary dimensions. It is generally described in terms of organizational factors such as the existence of learned societies, funds, awards, congresses, journals, doctoral schools or teaching departments, formal and informal networks of communication, etc. As observed in the very case of the sociology of science, a discipline is more than just an amount of shared knowledge and know-how—even though this formal and informal cognitive side is fundamental: it is at the same time a shared narrative about the origin of a social group, a set of rituals, norms, locations, a communication network, and it exists because it has been recognized as a discipline by other pre-existing disciplines (Dubois 2014a). All those various factors, through which disciplinary identity is made visible and collectively reproduced, are generally defined as attributes of scientific "professionalization". Hence the recurring idea that the categories of "discipline" and "profession" are almost synonyms, and the fact that it is common to refer to the "professional identity" of any discipline (Merton & Thacray 1972). The difficulty lies here in the fact that all scholarly activities do not maintain the same relationship to the categories of "profession" and "discipline", and that the term

"professionalization" amalgamates various occupational realities that it is essential to distinguish.

30 Obviously, in private as in public, scientists frequently depict themselves as "professionals" of science, i.e. individuals earning their living through the exclusive practice of science, and building, in the long run, a "career" in a three dimensional space—organizational, cognitive and relational (Prpic *et al.* 2014; Gläser & Laudel 2015). However, beyond this rather loose usage of the term, do scientists really share a same view of the notion of "profession"? It is useful here to note that elaborating on this notion is closely related to a focus on a specific activity. Regardless of the numerous theoretical backgrounds that underlay their research, the first sociologists who became interested in "profession" as an analytical category agreed on considering *medicine* as a "prototype" for all professions.[10] What are the main characteristics of this prototype? Without claiming to be exhaustive, four elements seem to play a central role.

31 (1) *Authority and Power,* first, are important components of medicine as a profession. As suggested by Parsons (1939: 460) in his classical lecture on *The professions and social structure*,

> [...] the professional practitioner in our society exercises authority. We speak of the doctor as issuing 'orders' even though we know that the only 'penalty' for not obeying them is possible injury to the patient's own health. A lawyer generally gives 'advice', but if the client knew just as well what to do it would be unnecessary for him to consult a lawyer.

32 While being sharply critical of the Parsonian functional theoretical framework, Larson (1977) or Abbott (1988) nonetheless considered that authority is a strategic dimension of any profession. A professional project is systematically a will to construct a "monopoly" and to increase, through this monopoly, occupational status and power.

33 (2) *Specialized knowledge, skills, capacities and services (and corresponding fees)* are a second important component of medicine as profession. Medicine is constructed as a specific area of applied knowledge.[11] For the physician to be considered as a professional, s/he must find, in the words of Wilensky (1964: 138), "a technical basis for it, assert an exclusive jurisdiction, link both skill and jurisdiction to standards of training, and convince the public that its services are uniquely trustworthy". The traditional divide between "occupation" and "profession" heavily relies on the reference to a sum of know-how and technical capacities described as inaccessible to lay persons.[12] The physician enjoys professional authority and social prestige as long as s/he is collectively perceived as the bearer of expert knowledge accumulated through a long process of education. In this respect, Parsons clearly emphasized the centrality of rationality for professions, such as medicine, that are closely related to the growth of scientific knowledge. In the same vein, Merton (1957: 21) observed that the link between medicine and the various sciences upon which medicine draws its cognitive support imposes a specific form of education and socialization: "Every considerable advance in medical knowledge [...] brings in its wake the pressing question of how this new knowledge can be most effectively taught to the student."

34 (3) *Ethical conduct* is a third important component of medicine as profession. On the basis of his early studies on the normative structure of science, Merton had no trouble developing a normative approach of medicine. To his eyes, the physician is a professional as long as, like any other professional, he has internalized a set of norms,

standards and values indicating what is permitted and what is proscribed, in other words, a set of normative principles that guarantee the possibility of self-regulation:

> [T]he physician in his private office is largely subject to the controls only of the values and norms he has acquired and made his own. The medically uninformed patient is not in a position to pass sound judgment upon the normative adequacy of what the physician does. (1957: 77)

35 This Mertonian discussion brings me to a fourth key component of medicine as profession.

36 (4) *Autonomy understood as the capacity of the community of physicians to regulate themselves through several mechanisms.* The professional order of medical doctors in France, or the College of Physicians and Surgeons in the USA are the most obvious manifestations of this collective self-regulation process. And these self-regulation bodies generally claim the exclusive right to determine who is legitimate to work as a physician and who is not. Studying the medical profession, Freidson (1970: 71-72) described "organized autonomy" as a strategic characteristic for any profession:

> a profession is distinct from other occupations in that it has been given [generally by the State, MD added] the right to control its own work. [...] And while no occupation can prevent employers, customers, clients, and other workers from evaluating its work, only the profession has the recognized right to declare such "outside" evaluation illegitimate and intolerable.

37 It is however important to note that this autonomy is not given once and for all: it is often challenged and reactivated through continuous competition and disputes with other professional groups. Wilensky has rightly pointed out that medicine is regularly doing battle with "marginal practitioners" such as osteopaths or chiropractors. More recently, these professional disputes were extensively analysed by A. Abbott (1988). For Abbott, it is not possible to understand individual professions without reconstructing the interplay of the "jurisdictional links" between professions. He uses the case of American medicine to demonstrate the complexity of such an interplay. Medicine "is not a continuous entity. Development activity, and interprofessional relations are bound together. The medical professions absolute control of bodily ills required defensive work in a number of borders" (Abbot 1988: 21).

38 Given the four elements that characterize medicine construed as a prototype for all professions, why is it still important not to adopt an interchangeable approach of the categories of "discipline" and "profession"? In my opinion, one should keep in mind at least three basic reasons.

39 Firstly, failing to distinguish between the categories of discipline and profession bars us from understanding the differences in nature between the activities of biologists and physicians, physicists and engineers, historians and lawyers, etc. A discipline (biology, physics, history, etc.) corresponds to an occupation devoted to the production of original and robust knowledge. Its core defining component is oriented toward a cognitive dimension.[13] A profession (medicine, law, engineering) is an occupation devoted to the application of available knowledge to human problems. Its defining component is the service relation between the professionals and their clients. This elementary distinction between, say, biologists and physicians, does not mean, of course, that they do not share some basic formal characteristics. Obviously biologists and physicians are highly trained experts: they use specialized knowledge and skills and contribute to producing them. They have their own specific normative subculture, a body of shared and transmitted ideas, values and standards—for the scientist, the

ethos of science described by Merton. They both also have jurisdictional claims (Abbott 1988), meaning rights to control the provision of particular services and activities. But these common features should not obscure the fact that some crucial differences remain. As emphasized by Freidson (1970: 22), there is a conceptual need to distinguish between profession and discipline, physicians and biologists:

> The former survive by providing to a varied lay clientele services that are expected to solve practical problems. [...] The latter, however, [...] can gain their monopoly over work solely by the conjunction of [...] association and state support. [...] These two types of occupation may be members of one very general class [...] but the conditions for their establishment and maintenance are so distinct that one risks great confusion by considering them together.

40 Secondly, failing to distinguish between the categories of discipline and profession bars us from adequately describing the socio-historical process of emergence of the scientific disciplines. All known modern disciplines stem from the three faculties that, in early modern Europe, provided a professional education: theology, law and medicine. However, as indicated by Stichweh (1992: 10),

> in the 19th century, scientific disciplines developed for the first time exclusively with their own personnel and separated themselves completely from the traditions of the three pre-existing faculties as far as their knowledge base and methodology was concerned. [...] Actually the classical professions, after the turn of the 19th century, represented not scholarly knowledge systems but action systems specializing in contacts between members of the profession and clients. Their respective knowledge bases were activated primarily for that purpose. Increasingly they developed a dogmatic—that is, action-stabilizing—character. In contrast, the disciplines represented closed communication complexes in which colleagues were seen as the disciplinary audience and clients were not known. A difference developed between internal closure and exclusive concentration on elaborating scientific truths on the one hand and reorientation toward action and application of knowledge in the contact between professional and client on the other. This difference is an indication of the increasing distance between scientific disciplines and professional action systems, not of the professionalization of science.

41 Through this historical narrative, Stichweh shows that the advent of our modern disciplinary infrastructure supposes a process of "de-professionalization" that led to assign the scientist to a "closed market", meaning a market in which there was only one kind of consumers: the other members of the scientific community, redefined as both "associates" and "rivals" in the production and circulation of knowledge.

42 Lastly, failing to distinguish between the categories of discipline and profession bars us from identifying not only the variety of regimes of scholarly activities, but also the capacity of the members of the academic sphere to switch, during their career, between these regimes. Against a too simplistic vision of science (mode 1 vs mode 2 or in other words discipline vs profession), there are only advantages in adopting a pluralistic approach oriented toward the analysis of the variety and the dynamics of scholarly activities and regimes. This general perspective was developed by T. Shinn (2002: 101) in his discussion of the transitory regime of science and technology:

> Analyses of the transitory science and technology regime maintain the idea of a demarcation between academia (discipline) and engineering (profession), but at the same time show how practitioners intermittently pass back and forth between the two arenas. In studies of the transverse science and technology regime, the idea of the institutional boundedness of science and engineering is preserved, but the focus is on situations where back and forth movement in unceasing. Practitioners structure divisions of labor in particular ways according to task requirements.

43 One historical example is enough to demonstrate the importance of this pluralistic approach: in their biographical study of William Thomson (known as Lord Kelvin), Smith and Wise (1989) documented how Thomson switched from mathematical physics to engineering, and from engineering back to physics. They incidentally point out that it is Thomson's involvement in the grandest of all Victorian engineering projects—the Atlantic telegraph cable—that earned him his knighthood. If one agrees to consider discipline and profession as two differentiated institutional arenas, one immediately sees the various amalgams at work in the ordinary discourse on the "professionalization" of science. This discourse contributes to mask the variety of identities associated to the functioning of the primary units of internal differentiation in science: "profession" (engineers) is one of these identities, "discipline" (researchers) is yet another.

Conclusion: "asymmetrical convergence" and the changing balance between discipline and profession

44 Recognizing the importance of the analytical distinction between "profession" and "discipline" does not imply that one should adopt a static representation of the equilibrium between these two categories. On the contrary, it is precisely that distinction that makes it possible to approach certain dimensions of the contemporary dynamics of science and technology (henceforth S&T); dynamics viewed as the consequence of the interaction between S&T construed as a profession, and S&T construed as a discipline.

45 One of these dimensions was depicted by Kleinman and Vallas (2001, 2006) as a process of "asymmetrical convergence". In the area of biotechnology, scientists working within the disciplinary regime are more and more compelled to respond to the constraints of the commercial world, while engineers and research engineers working in science-intensive firms find an autonomy and collegiality that are traditionally thought not to be available in the professional realm. For Kleinman and Vallas (2006: 36–37),

> [o]n the one hand, science-intensive firms find it useful to invoke academic conventions, such as the publishing of journal articles, sponsoring of intellectual exchanges, and supporting curiosity-driven research (though in complex and often contradictory ways that articulate with corporate goals). On the other hand, academic institutions increasingly resort to entrepreneurial discourses and practices [...]. The result, we contend, generates contradictions, anomalies, and ironies [...].

46 This simultaneous and ironic change at work in the life sciences is obviously a key issue. Every sociologist of science working on regenerative medicine (Brunet & Dubois 2012), nano-medicine (Louvel 2015) or epigenetics (Landecker & Panofsky 2013) is aware of this general trend. But such a phenomenon does not mean that the occupational dimensions of discipline and profession have nowadays merged into one single dimension. It means mostly that S&T actors have the capacity to transform, through their strategies and the corresponding structures of opportunity, the equilibrium between the arenas of profession and discipline, and by doing so to achieve a new collective identity. Yet, such a transformation generally corresponds to a new temporary equilibrium, and remains partly shaped by pre-existing norms and practices that belong to one occupational arena or the other.

BIBLIOGRAPHY

ABBOTT, A. 1988. *The System of Professions. An Essay on the Division of Expert Labor*. Chicago: The University of Chicago Press.

ADAMS, T.L. 2010. "Profession: A useful concept for sociological analysis?". *Canadian Review of Sociology* 47/1, 49-70.

BARNES, B. & J. RANDALL. 2012. "Doctoral student satisfaction: An examination of disciplinary, enrolment and institutional differences". *Research in Higher Education* 53/1, 47-75.

BARTON, R. 2003. "'Men of science': language, identity and professionalization in the mid-Victorian scientific community". *History of Science* 41/1, 2003, 73-119.

BROMAN, T.1995. "Rethinking professionalization: Theory, practice, and professional ideology in Eighteenth-century German medicine." *J. Mod. Hist*. 67, 835–72.

BRUNET, P., & M. DUBOIS. 2012. "Stem cells and technoscience: Sociology of the emergence and regulation of a field of biomedical research in France". *Revue Française de Sociologie* 53/3, 241–286.

CAMPBELL, R. 2003. "Preparing the next generation of scientists: The social process of managing students". *Social Studies of Science* 33/6, 897–927.

CHAMPY, F. 2009. *La sociologie des professions*. Paris: Presses Universitaires de France.

DELAMONT, S. & P. ATKINSON. 2001. "Doctoring uncertainty: Mastering craft knowledge". *Social Studies of Science* 31/1, 87–107.

DUBOIS, M. 2014a. "Private knowledge" et "programme disciplinaire" en sciences sociales : étude de cas à partir de la correspondance de R.K.Merton". *L'Année Sociologique* 64/1, 79-119.

DUBOIS, M. 2014b. "From discovery to invention. Sociological study of academic correspondence". *European Journal of Social Sciences* 52/2, 7–42.

FREIDSON, E. 1984 [1970]. *Profession of Medicine. A study of the Sociology of Applied Knowledge*. New York: Dodd, Mead & Company.

GARDNER, S. 2007. "'I heard it through the grapevine': doctoral student socialization in chemistry and history". *Higher education* 54/5, 723–740.

GIBBONS, M., C. Limoges, H. Nowotny, S. Schartzman, P. Scott & M. Trow. 1994. *The New Production of Knowledge. The Dynamics of Science and Research in Contemporary Societies*. London: Sage.

GINGRAS, Y. 1991. "L'institutionnalisation de la recherche en milieu universitaire et ses effets". *Sociologie et sociétés* 23/1, 41–54.

GIERYN, T. 1999. *Cultural Boundaries of Science. Credibility on the Line*. Chicago: The University of Chicago Press.

GLÄSER, J. & G. LAUDEL. 2015. "The three careers of an academic". Zentrum Technik und Gesellschaft, discussion paper 35.

GOLDE, C. 2005. "The role of department and discipline in doctoral student attrition: lessons from four departments". *Journal of higher education* 76/6, 669–700.

GOLDSTEIN, J.1984. "Foucault among the sociologists: The 'disciplines' and the history of the professions". *History and Theory* 23, 170–192.

GOLINSKI, G. 1998. *Making Natural Knowledge: Constructivism and the history of science*. Cambridge: Cambridge University Press.

HAGSTROM, W. 1965. *The Scientific Community*. New York: Basic Books, Inc.

HEILBRON, J. 2004a. "A regime of disciplines: Toward a historical sociology of disciplinary knowledge". In CAMIC, C. & H. JOAS, *The Dialogical Turn. New Roles for Sociology in the Postdisciplinary Age*. Lanham, MD and Oxford: Rowman & Littlefield Publishers, 23–42.

HEILBRON, J. 2004b. "The rise of social science disciplines in France". *Revue Européenne de Sciences Sociales* 42/129, 145–157.

KLEINMAN, D.L. & S. VALLAS. 2001. "Science, capitalism, and the rise of the 'knowledge worker': The changing structure of knowledge production in the United States". *Theory and Society* 30/4, 2001, 451–492.

KLEINMAN, D.L. & S. VALLAS. 2006. "Contradiction in convergence. Universities and industry in the biotechnology field". In FRICKEL, S. & K. Moore, *The New Political Sociology of Science. Institutions, Networks and Power*. Madison, WI: The University of Wisconsin Press, 35–62.

JACOBS, J. 2014. *In Defense of Disciplines. Interdisciplinarity and Specialization in the Research University*. Chicago: University of Chicago Press.

KNORR-CETINA, K. 1982. "Scientific communities or transepistemic arenas of research? A critique of quasi-economics models of science". *Social Studies of Science* 12/1, 101–130.

KNORR-CETINA, K. 1999. *Epistemic Cultures. How the Sciences make Knowledge*. Cambridge, MA: Harvard University Press.

LANDECKER, H. & A. PANOFSKI. 2013. "From social structure to gene regulation, and back: A critical introduction to environmental epigenetics for sociology". *Annual Review of Sociology* 39, 333–357.

LARSON, M. 1977. *The Rise of Professionalism: A Sociological Analysis*. Berkeley: University of California Press.

LEMAINE, G., R. MacLeod, M. Mulkay & P. Weingart (Eds.). 1977. *Perspectives on the Emergence of Scientific Disciplines*. Chicago: Aldine.

LENOIR, T. 1997. *Instituting Science. The Cultural Production of Scientific Disciplines*. Stanford, CA: Stanford University Press.

LOUVEL, S. 2015. "Effects of interdisciplinarity on disciplines: a study of nanomedicine in France and California". *Revue Française de Sociologie* 56/1, 69–97.

MACLEOD, R. 1972. "Resources of science in Victorian England: The endowment of science movement, 1868-1900". In MATHIAS, P. (Ed.), *Science and society 1600-1900*. Cambridge: Cambridge University Press, 111–145.

MCLEELAND, C.E. 1991. *The German Experience of Professionalization. Modern Learned Professions and their Organizations from the Early Nineteenth Century to the Hitler Era*. Cambridge: Cambridge University Press.

MERTON, R.K. 1973 [1942]. *The Sociology of Science. Theoretical and Empirical Investigations.* Chicago: The University of Chicago Press.

MERTON, R. K. 1957, "Some preliminaries to a sociology of medical education". In MERTON, R. K., G. Reader & P. Kendall (Eds.), *The Student Physician. Introductory studies in the sociology of medical education*. Cambridge, MA: Harvard University Press.

MERTON, R. K., G. Reader & P. Kendall (Eds.). 1957. *The Student Physician. Introductory studies in the sociology of medical education*. Cambridge, MA: Harvard University Press.

MERTON, R. K. & A. THACRAY. 1972. "On discipline building: The paradoxes of George Sarton". *Isis* 63/4, 472–495.

MULLINS, N. 1972. "The development of a scientific specialty: The Phage Group and the origins of molecular biology". *Minerva* 10/1, 51–82.

NYE, M.J. 1993. *From Chemical Philosophy to Theoretical Chemistry. Dynamics of Matter and Dynamics of Discipline–1800-1950*. Berkeley: University of California Press.

PARSONS, T. 1939. "The professions and social structure". *Social Forces* 17/4, 457–467.

PORTER, R. 1978. "Gentlemen and geology: The emergence of a scientific career, 1660-1920". *Historical journal* xxi, 809–836.

PRPIC, K., I. van der WEIJDEN & N. ASHEULOVA (Eds.). 2014. (*Re)searching Scientific Careers, Institute for the History of Science and Technology*. St Petersburg: Russian Academy of Science.

RESKIN, B. 1979. "Academic sponsorship and scientists' careers". *Sociology of Education* 52/3, 129–46.

SHINN, T. 2002. "Intellectual cohesion and organizational divisions in science". *Revue Française de Sociologie* 43, 99–122.

SHINN, T. & B. JOERGES. 2002. "The transverse science and technology culture: Dynamics and roles of research-technology". *Social Science Information* 41/2, 207–251.

SMITH, C. & N. WISE. 1989. *Energy and Empire. A biographical study of Lord Kelvin*. Cambridge: Cambridge University Press.

STICHWEH, R. 1991. *Études sur la genèse du système scientifique moderne*. Lille: Presses Universitaires de Lille.

STICHWEH, R. 1992. "The sociology of scientific disciplines: On the genesis and stability of the disciplinary structure of modern science". *Science in Context* 5-1, 3–15.

STICHWEH, R. 2003. "Differentiation of scientific disciplines: Causes and consequences". Encyclopedia of Life Support Systems (EOLSS). Paris: UNESCO.

WEBER, M. 2004 [1919]. *The Vocation Lectures*. Indianapolis, IN: Hackett Publishing Company.

WEIDMAN, J. & E. STEIN. 2003. "Socialization of doctoral students to academic norms". *Research in Higher Education* 44/6, 641–656.

WHITLEY, R. 1976, "Umbrella and polytheistic scientific disciplines and their elites". *Social Studies of Science* 6/3-4, 471–497.

WILENSKY, H.L. 1964. "The professionalization of everyone?". *American Journal of Sociology* 70/2, 137–158.

WRIGHT, J.D. (Ed.). 2015. *International Encyclopedia of the Social & Behavioral Sciences*. Philadelphia, PA: Elsevier.

ZUCKERMAN, H. 1978. *Scientific Elite: Nobel Laureates in the United States*. Chicago: University of Chicago Press.

NOTES

1. The recent second edition of *the International Encyclopedia of the Social & Behavioral Sciences* (Wright 2015) for example, presents no less than four entries for "discipline" and seven entries for "profession": Discipline-Building in the Social Sciences; Collective Memory, Biography and Autobiography; Development and Current Status of the Discipline of Criminology; Discipline Formation in the Social Sciences; Professions and Professionalization, History of; Social Science Professions and Professionalization; Lawyers: Social Organization of the Profession; Medical Profession; Professions in Organizations; Teaching as a Profession: United States; Professions, Sociology of.

2. For more details about the volume and distribution of these activities, see the annual science and engineering reports from national and international organizations such as the NSF <http://www.nsf.gov/statistics/2016/nsb20161/#/report>, UNESCO < http://www.uis.unesco.org/ScienceTechnology/Pages/default.aspx> or OECD <http://www.oecd.org/sti/msti.htm>.

3. The sum of "prescriptions, proscriptions, preferences and permissions [...] internalized by the scientist" (Merton 1973 [1942]: 269).

4. "Successful doctoral students master the tacit, indeterminate skills and knowledge, produce usable results and become professional scientists. As professional scientists, they learn to write public accounts of their investigations which omit the uncertainties, contingencies and personal craft skills" (Delamont & Atkinson 2001: 88). "Those scientists who learn to publish have been enculturated into their discipline, leaving the next generation of doctoral students to repeat the cycle" (*ibidem*: 104).

5. Socialization defined as an "all-encompassing immersion into an institutional setting, where every aspect of one's behavior appears to be controlled by some objective and impersonal force that is an integral part of the structure of science" (Campbell 2003: 900).

6. This second part is an extended version of the first section of Dubois (2014a).

7. "[S]cience has entered a stage of specialization that has no precedent and that will continue for all time [...]. Only rigorous specialization can give the scholar the feeling for what may be the one and only time in his entire life, that here he has achieved something that will last. Nowadays, a really definitive and valuable achievement is always the product of specialization. And anyone who lacks the ability to don blinkers for once and to convince himself that the destiny of his soul depends upon whether he is right to make precisely this conjecture and no other at this point in his manuscript should keep well away from science" (Weber 2004 [1919]: 7–8).

8. See also Heilbron (2004a: 30): "The distinctive characteristic of modern disciplines is precisely to organize teaching, research and professional organization within the same kind of institutional unit".

9. For an example, cf. the failed institutionalization of the collective of US sociologists of invention in the 1940s, Dubois (2014b).

10. "[I]t was felt that sociological study of the medical school would afford a *prototype* [italics added, MD] for comparable studies in the other professions [...] the other professions frequently look to medicine as a model [...]" (Merton 1957: 37); "[...] the profession of medicine [...] has come to be the *prototype* [italics added, MD] upon which occupations seeking a privilege status today are modeling their aspirations (Freidson 1984 [1970]: xviii). It is also worth noting that in one of the first seminars on professions in Columbia University in 1950, eight professions were represented: medicine, law, architecture, engineering, social work, the ministry, nursing and education.

11. Eliot Freidson's book on the profession of medicine has a subtitle: A study of the sociology of applied knowledge.

12. This divide between occupation and profession has no real equivalent in French, see Champy (2009). For a critical discussion of this divide, see Adams (2010).

13. This prevalent cognitive dimension of the category of discipline was emphasized by Mary Joe Nye: “the core of the scientific discipline is missed if the discipline’s particular values and characteristic problems are not noted and understood” (1993: 20).

ABSTRACTS

Although key categories in sociology since Max Weber, “profession” and “discipline” are often used in a superficial manner, without any rigorous definitions. This article provides examples of impressionistic approaches of those two notions by analyzing studies on the socialisation process in the world of science. Building from E. Freidson (1970 [1984]), Y. Gingras (1991) and R. Stichweh’s (1992) general line of arguments, I propose three main reasons to justify the need to consider “discipline” and “profession” as two distinct phenomena that the sociologist should study from the perspective of their interaction, but also of their transformation.

Bien que les catégories de « profession » et de « discipline » occupent une place centrale en sociologie depuis Max Weber, elles sont souvent utilisées de façon imprécise, sans être rigoureusement définies. Cet article fournit des exemples d’approches impressionnistes de ces notions en s’appuyant sur l’étude du processus de socialisation dans le monde scientifique. En se fondant sur les travaux d’E. Freidson (1970 [1984]), de Y. Gingras (1991) et de R. Stichweh (1992), j’avance trois raisons principales qui justifient le besoin de considérer « discipline » et « profession » comme deux entités distinctes que le sociologue devrait étudier du point de vue de leurs interactions ainsi que de leur transformation.

INDEX

Keywords: discipline, profession, science, sociology, vocation
Mots-clés: discipline, métier, profession, science, sociologie

AUTHOR

MICHEL DUBOIS

Michel Dubois is a CNRS Senior Research Fellow at the Groupe d’Étude des Méthodes de l’Analyse Sociologique de la Sorbonne (GEMASS, Paris Sorbonne University). He teaches and publishes on issues of the sociology of science and technology. His most recent publications address issues at the crossroads between sociology and biomedical research. He is a member of the French National Research Committee and a member of the editorial boards of the European Journal of Sociology and the French Sociological Review. He is the author of Social Dynamics of Biomedical Research. An Actionist Perspective on the Sociology of Science (The Bardwell Press 2012) and co-author of "Stem cells and technoscience: Sociology of the emergence and regulation of a field of biomedical research in France" (Revue Française de Sociologie 53/3, 2012).
michel.dubois@cnrs.fr